Description of *Microtyphlus (Speleotyphlus) infernalis* n. sp. from Valencia (eastern Iberian Peninsula), and review of the present state of knowledge of this hypogean subgenus (Coleoptera: Carabidae: Anillini)

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Description of *Microtyphlus (Speleotyphlus) infernalis* n. sp. from Valencia (eastern Iberian Peninsula), and review of the present state of knowledge of this hypogean subgenus (Coleoptera: Carabidae: Anillini). - A new species of cave-dwelling Anillini carabid *Microtyphlus (Speleotyphlus) infernalis* n. sp. found in a single cave ('Cova Soterranya', in Serra Calderona's Natural Park, a protected area belonging to the Valencian Autonomous Community) is described. In this cave, the populations are located in the aphotic zone, being subject to rather buffered variations of the abiotic factors and living in a biocoenosis with opportunistic elements and a low number of troglodytic forms, thus possessing a greater degree of biodiversity than the deeper zone of the cave.

M. infernalis n. sp. is the most southern species of the subgenus *Speleotyphlus*. A total of six species belong to this subgenus. Three of them *(M. (S.) comasi*, *M. (S.) fadriquei*, and *M. (S.) virgillii)* are poorly known; the existing descriptions provide insufficient details and are largely inaccurate. Although its slenderness makes it look like *M. (S.) auroxi*, some features in the aedeagus of the new species show similarities with the most troglobiomorphic species of the tribe Anillini in the Iberian Peninsula, *Aphaenotyphlus alegrei*. A comparison of the main morphological characteristics of the species belonging to the *Speleotyphlus* subgenus reveals the need for a thorough revision of the whole group, which could be paraphyletic.

Keywords: Coleoptera - Anillini - taxonomy - new species - cave fauna - troglobiomorphism.

INTRODUCTION

The Iberian Peninsula's subterranean environment has been colonised by an enormous diversity of organisms. Among these, we can identify a huge number of endemic carabids (Jiménez-Valverde & Ortuño, 2007). We can also recognise two different subterranean habitats: the endogean and the hypogean environments, both showing a very characteristic fauna (Casale *et al.*, 1998: 1049). On one hand, in the

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hypogean environment (represented by caves and by the surface subterranean environment), the fauna show a particular body design tending to slenderness and giantism, all as a result of an adaptation to wide subterranean spaces. On the other hand, small body designs with short appendages have been selected in the endogean environment (i.e., the soil's horizon B interstices).

The tribe Anillini, found worldwide, comprise numerous subterranean species, bringing micropredators to the endogean environment's biocoenosis. In this way, most of these species are confined to the soil's small interstices, although some of them are adapted to those wide and deep subterranean spaces (pits and caves) known as hypogean environment. In the Iberian Peninsula, this fact has been observed in certain *Geocharis* Ehlers, 1883 (Barranco com. pers.), *Microtyphlus* Linder, 1863 (Ortuño & Carabajal, 1997: 139; Viñolas & Escolà, 1999) and *Hypotyphlus* Jeannel, 1937 (Español, 1971; Español & Comas, 1984; Ortuño, 1997) species. Nevertheless, there are some Anillini lineages which seem to have firmly colonised this hypogean environment, living in it exclusively and consequently representing a remarkable troglobiomorphic specialisation (Casale *et al.*, 1998: 1058). Such is the case of two monobasic genera located in the Iberian Peninsula (Ortuño, 2006; Ortuño & Sendra, 2007): *Aphaenotyphlus* Español & Comas, 1985 (*A. alegrei*), and *Iberanillus* Español, 1971 (*I. vinyasi*). Moreover, there are also other hypogean species in the eastern Iberian Peninsula showing different degrees of stylisation, which are included in the taxon *Speleotyphlus* Jeanne, 1973. Recently (Ortuño & Sendra, 2007), this taxon was reclassified as a subgenus of *Microtyphlus*. *Speleotyphlus* unites a small subset of *Microtyphlus* species with an ecological trend towards the occupation of the hypogean environment; it presents minor troglobiomorphic features (body stylisation), which are especially noted in the length of the appendages.

So far, five *Speleotyphlus* species have been described (Español, 1966; 1971; 1999; Vives *et al.*, 2002) (Fig. 7). *Microtyphlus (Speleotyphlus) aurouxi* Español, 1966 and *Microtyphlus (Speleotyphlus) jusmeti* (Español, 1971) are known in several coastal carbonated mountains between Oropesa-Cabanes and the La Vall d'Àngel Mountains (Castellón). *Microtyphlus (Speleotyphlus) fadriquei* (Español, 1999) has been found in a cavity in La Mola de Godall (Ulldecona, Tarragona). The northern side of the distribution area has been occupied by *Microtyphlus (Speleotyphlus) virgilii* (Vives *et al.*, 2002), which was found in some cavities in Serra d'Almós (Tarragona). Finally, *Microtyphlus (Speleotyphlus) comasi* (Vives *et al.*, 2002), distinguished from a single female specimen, has been found in a cavity in the interior mountains of the Maestrazgo region (Iglesuela del Cid, Teruel).

In this paper, *Microtyphlus (Speleotyphlus) infernalis* n. sp., the most southern species of the subgenus, is described.

MATERIAL AND METHODS

Table 1 shows the studied *Speleotyphlus* species and specimens.

Some specimens were washed in distilled water and prepared for microscopic examination with slides, glass coverslips and acetate sheets, using dimethyl hydantoin formaldehyde (DMHF). Most specimens were prepared following traditional methods, glued onto entomologic cards.

TABLE 1. Material examined

Species	Number of specimens	Location	Deposit collection
M. (S.) aurouxi	1 ♂, 3 ♀	Avenc d'En Serenge, Cabanes (Castellón – Spain), 25-IV-2006, A. Sendra leg.	VMO/AU
	1 ♂, 1 ♀	Avenc d'En Serenge, Cabanes (Castellón – Spain), 06-III-2008, V.M. Ortuño leg.	VMO/AU
M. (S.) jusmeti	1 ♂, 1 ♀	Avenc del Mas d'Abad, Coves de Vinromà (Castellón – Spain). 04-IX-2005. A. Sendra leg.	VMO/AU
M. (S.) fadriquei	1 ♂	Cova d'En Masega, Llabería (Tarragona – Spain), 14-IV-2008, F. Fadrique leg. [new locality]	VMO/AU
M. (S.) virgilii	1 ♂	Cova Bonica, Ulldecona (Tarragona – Spain), 11-VI-2006, A. Sendra leg.	VMO/AU
***M. (S.) infernalis* n. sp.**		See type series	

The aedeagus was extracted from the abdomen and separated from the tergal apodemal ring; the parameres were separated from the associated membranes at the surface of the median lobe. Genitalia were mounted in dimethyl hydantoin formaldehyde (DMHF) and placed on an acetate slide.

A routine procedure was followed to prepare the female reproductive appendages for scanning microscopy. The terminal abdominal segments of the female were gently squeezed with forceps and placed in a saturated KOH solution for eight hours. After that, they were washed in Scheerpeltz's solution (see Ortuño *et al.*, 1992: 148) and opened dorsally to check the alkaline digestion. Staining was carried out with Chlorazol black E® in aqueous solution for 20 seconds under visual monitoring. The excess dye was removed by washing it in KOH, and the structures were washed again in Scheerpeltz's solution. The female genital preparations were included in DMHF and placed on an acetate slide.

Two specimens of *M. infernalis* n. sp. were coated with palladium-gold for scanning electron microscopy (HITACHI S-4100).

The specimens were then added to Vicente M. Ortuño's (VMO/AU) collection at the Zoology and Physical Anthropology Department of the University of Alcalá, in the Museu Valencià d'Història Natural (MVHN), and the Muséum d'histoire naturelle de Genève (MHNG).

RESULTS AND DISCUSSION

Microtyphlus (Speleotyphlus) infernalis n. sp. — Figs 1-5

HOLOTYPE: ♂, Spain, Valencia, Serra, «Cova Soterranya» cave, [30SYJ155961, MGRS Datum: EUR-7]; 06-I-2004; A. Sendra leg.; VMO/AU coll.

PARATYPES: 1 ♀, collection locality as for holotype; 06-IV-2003; MHNG coll. – 1 ♂ and 1 ♀, collection locality as for holotype; 18-IV-2004; VMO/AU coll. – 1 ♂ (in microscopic preparation), collection locality as for holotype; 18-IV-2004; VMO/AU coll. – 2 ♂, collection locality as for holotype; 06-I-2004; VMO/AU and MVHN coll. – 1 ♀, collection locality as for holotype; 11-II-2005; MVHN coll.

ETYMOLOGY: The name of the specific epithet comes from the 'infernal' (hellish) characteristics of the subterranean spaces, particularly from the name of the typical locality, 'Soterranya' (= subterranean).

DIAGNOSIS: Possessing general Anillini characteristics. Lacking eyes (Figs 1 and 2e), and apterous. Depigmented integument showing isodiametric micro-sculpture (Figs 2a, 2b and 2d) and a sparse covering of short setae on the head, pronotum, and elytra. The pronotum's posterior marginal setae are inserted in front of the posterior angles. The elytra are complete, elliptical and convex, covering almost the entire abdomen (Fig. 1). The male's first segment anterior tarsus is slightly dilated. Length (from the mandible's apex to the elytra's end): 2.24-2.39 mm.

DESCRIPTION: Head (Figs 1 and 2e) is as long (from the temples' end to the clypeus) as it is wide (eye/ocular area). Mandibles are conspicuous. Typical Bembidiinae's labial and maxillary palps (Fig. 2f). Tetrasetulated labium (Fig. 2g) with complete labial prebasilar suture; the labium shows a shallowly notched apical margin, with each side of the lateral lobe having a narrowly obtuse apex. Labrum is trapezoidal. Antennae are filiform (Fig. 1) (not monoliform, as in Anillini's endogean forms), setulated and covered with tomentum from the second to the 11^{th} antennomeres. Its antennae show several features which have also been observed in other Anillini (see Ortuño & Sendra, 2007): the last antennomeres are provided with several different sensillar types, mainly *sensilla trichodea* and *sensilla chaetica*, but the most conspicuous are two types which are located all along the last antennomeres, the *sensilla coeloconica* or *sensilla ampulacea*-type chemo-receiver pores, and one of the types of finger-shaped *sensilla chaetica*, both of them sparse and gathered at sub-apical areas (Fig. 3a and 3b). Ocular area is smooth, lacking eyes and ocular scars. The cephalic disk shows a scarce micro-pubescence which is more dispersed than on the pronotum and the elytra. Cephalic chaetotaxia (Figs 1 and 2e): one seta in the mandible's scrobe; six labral setae (the more external they are, the longer); one seta on each side of the clypeus; one seta on the distal side of each front sulci; two supraocular setae (anterior and posterior) on each side of the head.

The cordiform pronotum is slightly wider than longer. The edges are rounded in the two anterior thirds and sinuous in the posterior third. The anterior angles become inconspicuous, while the posterior ones are straight and sharp. The pronotal disk is crossed by a soft longitudinal sulcus. The side canal is wide and regular. Pronotal chaetotaxia (Fig. 1): two marginal setae (on each side): the anterior one at the distal quarter and the posterior one in the vicinity of the angle.

The prosternum (Fig. 3d) has a tongue-shaped intercoxal apophysis.

Elytra are elliptical and convex (Fig. 1) covering almost the entire abdomen, 1.5 times longer than wide (maximal width approximately at middle). Humeral region is rounded and fairly pronounced (little prominent shoulders) (Figs 1 and 2c). The side margin is slightly serrated on its two anterior thirds and edged by short setae (Fig. 2c). The scutellum is big and triangular, lacking stretch marks.

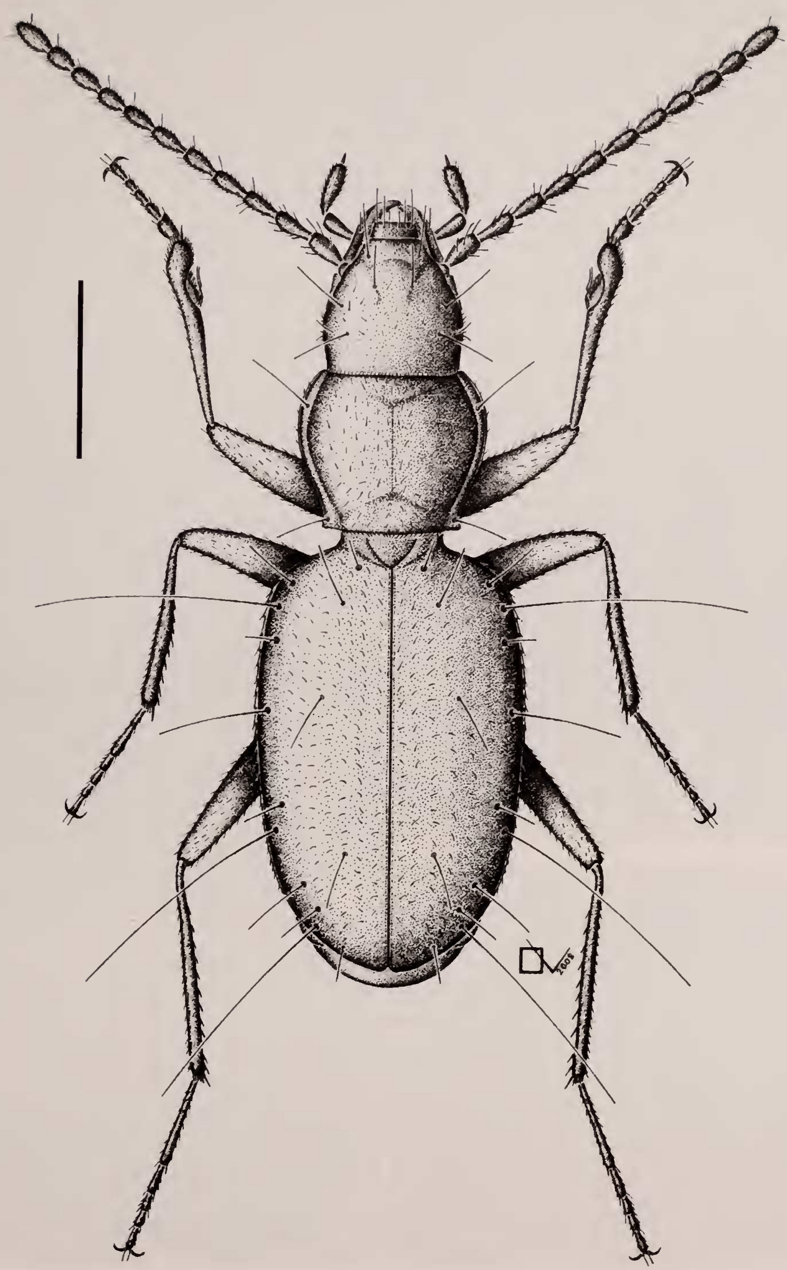

FIG. 1
Habitus of *Microtyphlus (Speleotyphlus) infernalis* n. sp. (scale: 0.5 mm).

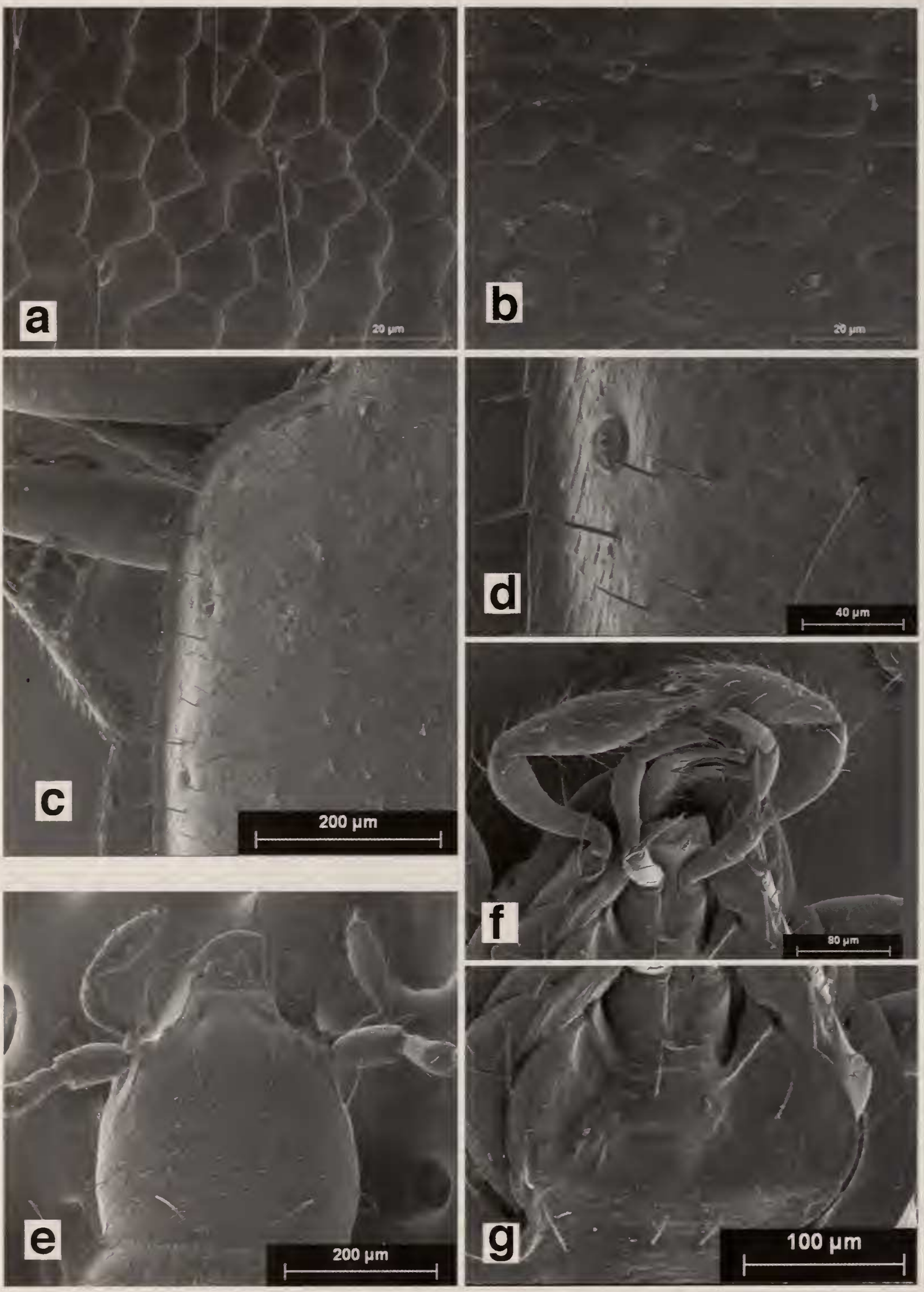

FIG. 2

Scanning electron microscope photography of *Microtyphlus (Speleotyphlus) infernalis* n. sp. (a) Micro-sculpture of the cephalic disk. (b) Micro-sculpture of the pronotal disk. (c) Elytron humeral area (d) Micro-sculpture of the elytron. (e) Head in dorsal view. (f) Labial pieces and maxillary palps. (g) Labium and prebasilar setae.

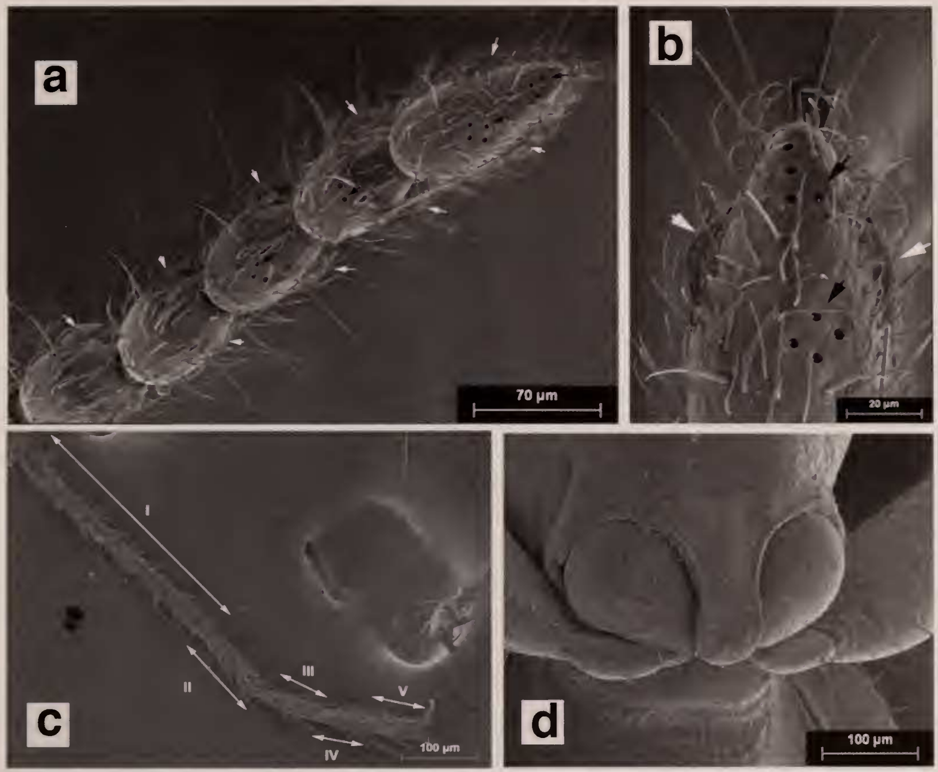

FIG. 3

Scanning electron microscope photography of *Microtyphlus (Speleotyphlus) infernalis* n. sp. (a) Last antennomeres. (b) Detail of the XI-antennomere (black arrow: *sensilla coeloconica*; white arrow: finger-shaped *sensilla chaetica*). (c) Metatarsus. (d) Prosternum.

Elytral chaetotaxia (Figs 1 and 2c): the parascutellar pore is located at a level with the elytral suture; three distal setae (anterior seta at a level with the second umbilicated seta; middle seta slightly ahead of the fourth umbilicated seta; posterior seta ahead of the seventh umbilicated seta; the umbilicated series is made up of nine setae. The second, sixth, and ninth setae are very long. The first three setae are gathered together and equidistant. The fourth seta is very distant from the third one and from the fifth-sixth pair (which are very close together); the seventh, eighth and ninth setae form a triangle (without a geminate pair); the apical seta is almost aligned with the posterior disk seta.

The legs (Fig. 1) are longer than what is usual in other Anillini Iberian genera. The first protarsomere is slightly dilated and ventrally covered by adhesive phaneres in the male (there is no other secondary sexual dimorphism on the legs). The mesal surface of the protibia bears a cleaning organ. Both the meta- and the mesotarsi are strongly setulose and show a markedly elongated first tarsomere, which is nearly as long as the next four tarsomeres combined (Figs. 1 and 3c). Coxae show micro-sculpture (Fig. 3d).

The abdomen is ventrally setulose. The female's last sternum shows four long setae near the apical margin, whereas the male bears only two.

The aedeagus (Figs. 4a and 4b) has a short, voluminous median lobe; its most sclerotised areas are the internal piece, the basal lamina, the apex, and the region where the parameres are articulated. The basal lamina bends towards the slightly raised apex. The apex bends towards the right in the dorsal view. The lobe media is very poorly sclerotised, especially at the base. The internal sac is voluminous, mainly membranous, with a long helminthoid-shaped sclerite and a dorsal sulcus in an anterior position. The parameres are asymmetrical; the right one is smaller, and both are bisetulated.

Female genitalia are shown in Figs 5a and 5b. The genital shield is made up of three pieces at both sides of the plane of symmetry: dimerous IX-gonopods (gonocoxite + gonosubcoxite) plus a IX-laterotergite. The IX-gonocoxite is unguiform, very sclerotised, with two long setae inserted close to the external edge: one of them is located on the ventral surface, while the other one is on the dorsal surface; the gonocoxite shows a mediodorsal fovea, in which a thin, long sensory seta is housed. The IX-gonocoxite, little sclerotised and lacking setae, is almost two times longer than wide. The IX-laterotergite is aliform, oblique, and slightly sclerotised, showing a membranous basal margin bearing 15 medium-length spine-shaped setae. The spermathecal complex is partially membranous (Fig. 5b). The duct of the spermatheca is short (less than 0.1 mm), sinuous, and thick over the entire length. The spermatheca is slightly sclerotised, bacilliform, and twice as long as wide. The spermathecal gland is large and sclerotised in the distal half and in part of the proximal half, pouring into the middle region of the seminal receptacle.

Taxonomic remarks: Jeanne (1973) placed the genus *Speleotyphlus* inside the Scotodipnina subtribe. In an Iberian context, it shows affinities with the genera *Microtyphlus*, *Hypotyphlus* and *Aphaenotyphlus*. Recently Ortuño & Sendra (2007), downgraded *Speleotyphlus* to a subgenus of *Microtyphlus*.

Dealing with the study of a new *Speleotyphlus* is a difficult task in spite of the small number of identified species. The original descriptions are often inaccurate and lacking in detail, and can occasionally even be misleading. In this context, it is worth mentioning a very significant aspect: the tegument micro-sculpture. The depth of the micro-sculpture varies, and has been used to distinguish *Speleotyphlus* species. However, there are no illustrations thus far, and therefore differences in micro-sculpture depth have thus far been sparsely used. Most of the diagnostic value of micro-sculpture cannot be exploited until a thorough taxonomic revision of the group has been conducted. The problem is best exemplified by *M. aurouxi*, which reportedly has a smooth tegument (without micro-sculpture) (Español, 1999: 57; Vives *et al.*, 2002: 99), but close observation under an optical microscope revealed that a micro-sculpture is present, although admittedly it is rather shallow.

Another problem of significant taxonomical importance concerns the aedeagi. Based on our experience, these structures easily lose their shape when prepared for optical microscopy using traditional techniques instead of DMHF without pressing the genital structures (see Materials and Methods). Perhaps this is the reason why Español (1966, 1999) reported two different interpretations of the aedeagus of *M. (S.) aurouxi*.

The larger size and a combination of features compared to other Anillini differentiate *M. infernalis* n. sp. from other species among the known *Speleotyphlus* of

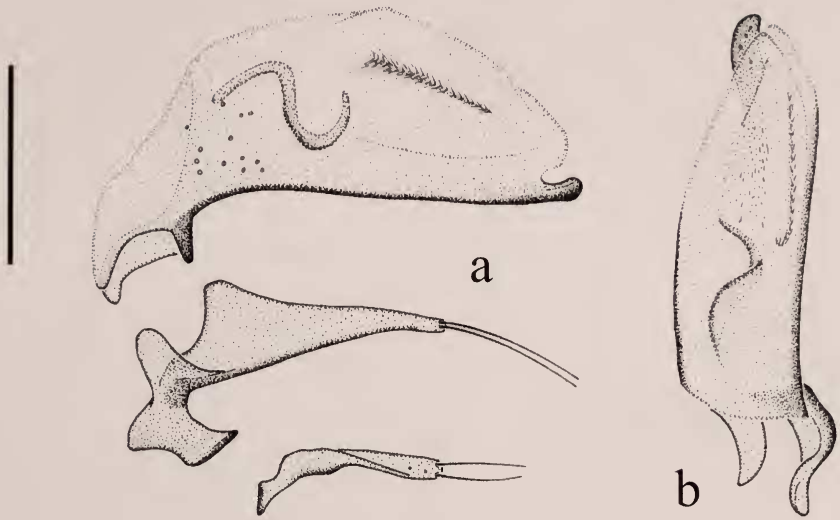

FIG. 4
Male genitalia of *Microtyphlus (Speleotyphlus) infernalis* n. sp. (a) Left side of median lobe and parameres in lateral view. (b) Median lobe in dorsal view (scale: 0.1 mm).

the '*Microtyphlus-Hypotyphlus-Aphaenotyphlus* phyletic series'. Despite an external morphology which places it among the *Speleotyphlus*, the configuration of the aedeagus in *M. infernalis* n. sp. strongly differs from that of the rest of this species group. Interestingly, the type of aedeagus, including its conspicuous apex bending to the right-hand side and the singular sclerotised piece on the internal sac, is very similar to that in *Aphaenotyphlus alegrei* (Ortuño & Sendra, 2007). This fact could actually mean that *Speleotyphlus* is an artificial group bringing together several lineages related to *Microtyphlus*, and showing adaptations to the hypogean environment. The genital characteristics of *M. infernalis* n. sp. bring it closer to *A. alegrei*, without rejecting the possibility of its being an 'aphaenopsian' representative of *Speleotyphlus (sensu lato)*. In addition, the geographical proximity between these two species (Fig. 7) strengthens the hypothesis of their close relationship, and of the possible paraphyly of *Speleotyphlus*.

Microtyphlus infernalis n. sp. shows several morphological characteristics which support its distinction from other similar species. As in other Anillini, the male genitalia are diagnostic (Figs 4 and 6).

Microtyphlus infernalis n. sp. is the most southern species of its subgenus (Fig. 7). It was found at nearly 60 kilometres from the locality where the nearest species *M. aurouxi* occurs.

Microtyphlus infernalis n. sp. has an aedeagus (Fig. 4) which is very distinct from that of *M. (S.) aurouxi* (Fig. 6a). Furthermore, in the new species, the posterior angles of the pronotum are conspicuous, the elytra are elliptical (1.5 times longer than wide), and its shoulders are slightly prominent. *M. aurouxi* differs considerably in that

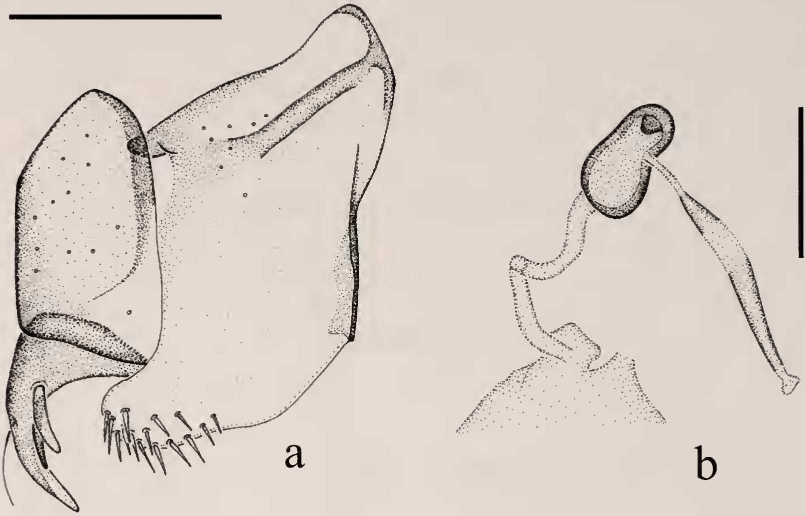

FIG. 5

Microtyphlus (Speleotyphlus) infernalis n. sp., female genitalia (a) Right-side of external genitalia (= genital shield) in ventral view. (b) Spermathecal complex. (scales, a: 0.1 mm and b: 0.05 mm).

the pronotum has obtuse posterior angles (more or less rounded), its elytra are proportionally narrower and longer (two times longer than wide), and its shoulders are much less prominent. This last characteristic makes it easy to distinguish *M. aurouxi* from the rest of the *Microtyphlus* species.

Microtyphlus infernalis n. sp. also differs from *M. jusmeti* by its aedeagal characteristics (Figs 4 and 6b), especially in the shape of the apical lamina and of the sclerites of the internal sac. In addition, *M. jusmeti* is the most robust species of *Speleotyphlus*. This species shows an almost transversal pronotum (slightly cordiform) with its posterior angles acuminated (projected outward), and the elytra with very prominent shoulders.

Despite their differences, *M. infernalis* n. sp., *M. aurouxi*, and *M. jusmeti* have a narrow and elongate aedeagal apex in common. This characteristic is absent in the aedeagus of *M. fadriquei*, whose apex is thick and short (Fig. 6c). *M. infernalis* n. sp. and *M. fadriquei* also present distinguishing elytral outlines. *M. comasi* differs notably from *M. infernalis* n. sp. in that its elytra are noticeably sub-parallel, longer (two times longer than wide), having very prominent shoulders (almost angular). Both species have a cordiform pronotum, but it is a bit wider than long in *M. infernalis* n. sp., while it is as long as wide in *M. comasi*.

Finally, *M. infernalis* n. sp. is approximately one-third longer than *M. virgilii*. Moreover, the aedeagus of *M. virgilii* is not prominent and has a very little sclerotised apex, as well as an internal sac with very slightly sclerotised structures (Fig. 6d), while *M. infernalis* n. sp. has a conspicuous apical lamina, and the internal sac has a large and remarkably sclerotised internal piece.

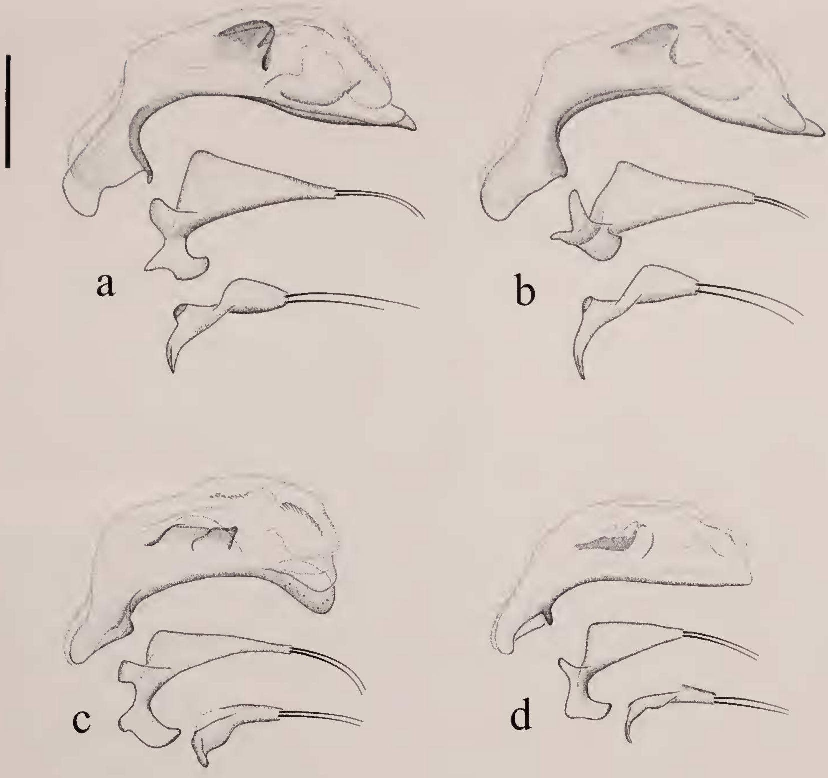

FIG. 6

Male genitalia (median lobe and parameres in left lateral view) of *Speleotyphlus* species. (a) *Microtyphlus (S.) aurouxi*. (b) *Microtyphlus (S.) jusmeti*. (c) *Microtyphlus (S.) fadriquei*. (d) *Microtyphlus (S.) virgilii*. (scale: 0.1 mm).

KEY TO THE SPECIES OF *SPELEOTYPHLUS* SUBGENUS:

1a Pronotum with obtuse, slightly rounded posterior angles. Elytra are elliptic with barely marked shoulders. Aedeagus (Fig. 6a) with an acuminated apex; basal lamina very sclerotised; internal sac with a trapezoidal sclerite. Length: 2.2-2.4 mm. . . . . *M. (S.) aurouxi*

1b Pronotum with right or acute posterior angles. Vertex blunt or conspicuous . (2)

2a Elytra sub-parallel, twice as long as wide; shoulders protruding and angular. [Male unknown]. Length: 2 mm. *M. (S.) comasi*

2b Elytra 1.5 to 1.8 times longer than wide; shoulders more or less protruding, but never angular . . . . (3)

3a Pronotum with posterior angles very protruding. Shoulders well marked . . . (4)

3b Pronotum with posterior angles hardly protruding. Shoulders barely marked . . . . (5)

4a Pronotum with acute and little diverging posterior angles. Antennae moniliform. Aedeagus curved with a widely rounded apex; large inner sac with a slightly sclerotised piece, elongated like a rectangular lamina (Fig. 6c). Length: 1.7-2.1 mm. . . . . *M. (S.) fadriquei*

4b Pronotum with blunt, sub-right posterior angles. Antennomeres oval. Aedeagus (Fig. 6b) with acuminated apex; very sclerotised basal lamina; inner sac showing a slightly sclerotised piece with an ill-defined outline. Length: 2.1-2.6 mm. . . . . *M. (S.) jusmeti*

5a Longer and more stylised appendages: filiform antennae; metatarsus with its first tarsomere (more than 10 times longer than wide) longer than the combination of the other four. Aedeagus (Fig. 4) with a prominent, slightly raised, rounded, sclerotised apex; inner sac with a long, helminthoid-looking sclerotised piece. Length: more than 2 mm (2.24-2.39 mm). . . . . *M. (S.) infernalis* n. sp.

5b Considerably shorter appendages: moniliform antennae; metatarsus with its first tarsomere (five times longer than wide) shorter than the combination of the other four. Aedeagus (Fig. 6d) with a non-sclerotised, non-prominent, rounded apex; inner sac with an approximately spatuliform, strongly sclerotised piece. Length: less than 2 mm. . . . . *M. (S.) virgilii*

SUBTERRANEAN ECOSYSTEM: The typical locality of *M. infernalis* n. sp. is a subterranean space known as the 'Cova Soterranya'. This cave is located at a height of 400 m in the 'Serra Calderona' (Fig. 7), a mountain range separating the Palancia and Turia river basins between the provinces of Valencia and Castellón (Spain). The 'Serra Calderona' region is part of the eastern foothills of the Iberian Mountain Range's Castilian Branch (Garay, 1995).

The 'Cova Soterranya' is 1 810 m long with a slope that descends 100 m (Fernández *et al.* 1980). It is made up of a combination of tectonic shapes and karstic dissolving, dug out in liasic limestone during the Inferior Jurassic period. Its morphology is extremely labyrinthine, with a continuous series of rooms and crevices presenting an outstanding clastic morphology which is sometimes interrupted by lithochemical processes of some significance (Garay, 2001).

Microtyphlus infernalis n. sp. has been found in three particular areas between 20 and 50 meters from the entrance. Two are located in the galleries which give access to the so-called 'Saló Gran', and the third is in the highest and dampest level of this room. The specimens are usually found under stones that are slightly or not at all buried in the wet soil and clay substratum resulting from a scant filtration of water runoff. When measured, room temperature oscillated between 15 and 16° C, and the relative humidity exceeded 85%. These areas are located in the aphotic zone, and are somewhat affected by variations in abiotic factors. The rare trophic resources have different origins, primarily organic remains coming from the outside, with some leaves and little sticks, as well as micro-mammal and chiroptera excrement, apart from invertebrate remains that are generally in different degrees of decomposition due to the presence of saprophytic fungi.

M. infernalis n. sp. lives in a community comprising a number of secondary consumers (principally detritivores) and, to a lesser extent, some micro- and macro-predators. Among the consumers, two troglobitic elements are remarkable. First is *Anillochlamys subtruncatus* Jeannel, 1930, a leiodid beetle which is found in several cavities throughout the Valencian-Castellonian regions of El Camp de Turia, La Plana

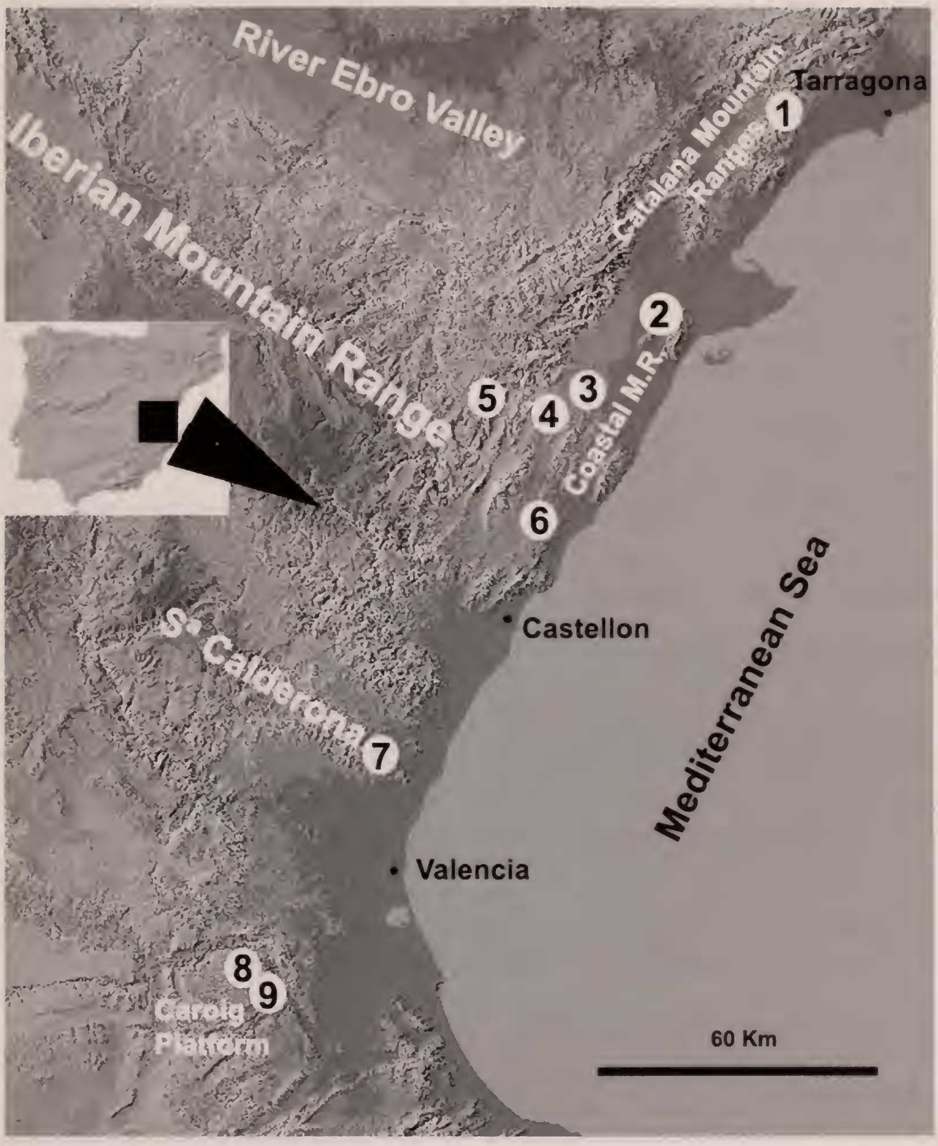

FIG. 7

Eastern Iberian Peninsula map with *Speleotyphlus* and *Aphaenotyphlus* species distribution. (Coastal M.R.: Coastal Mountain Ranges): 1. *M. (S.) fadriquei* from Avenc de la Llamborda (Tarragona); 2. *M. (S.) virgilii* from Cova Bonica (Tarragona); 3 and 4. *M. (S.) jusmeti* from Cova dels Encenalls and Cova del Mas d'Abat (Castellón); 5. *M. (S.) comasi* from Cueva del Turcacho (Teruel); 6. *M. (S.) aurouxi* from Avenc d'En Serenge (Castellón); 7. *M. (S.) infernalis* n. sp. from Cova Soterranya (Valencia); 8 and 9. *A. alegrei* from Cova Dones and Cova de les Gralles (Valencia).

Baixa, and El Alto Mijares (Salgado, 2006). Second is *Paratachycampa peynoensis* Bareth & Condé, 1981 (Sendra, 2006), a dipluran species found exclusively in caves in the 'Serra Calderona'. The latter species is included in the 'Valencian Catalogue of Threatened Fauna' as 'vulnerable' (DOGV, 2004). Many other troglophile species live together with these troglobites. Among them, *Armadillidium espanyoli* Cruz, 1990 (García Socias, 2006) and the gastropod *Hypnophila malagana* Gittenberger & Menkhorst, 1983 stand out, in addition to several mites and collembolan species as well as a variety of preimagal stages of beetles. Among the most abundant predators we can find *Lithobius* Leach, 1814 (myriapoda), liniphid arachnids, opillions like *Leiobonum levantinum* Prieto & Fernández, 2007, and *Chthonius (Ephippiochthonius)* (pseudoscorpionida). *Staphylinidae* beetles are also abundant, especially *Sepedophilus cavicola* (Scriba, 1870) and, to a lesser extent, a troglobite macro-predator: the carabid *Laemostenus (Antisphodrus) levantinus* Bolívar, 1919. *M. infernalis* n. sp. is thus part of a biocoenosis with opportunist elements and a smaller number of troglobite forms, and is more diverse than those found in deeper zones of the cave. The trophic factors influencing the composition of these troglobitic biocoenoses have been outlined by Poulson & Lavoie (2000). Although bat guano is part of the trophic resources of the troglobitic biocoenosis, *M. infernalis* n. sp. has not been found in areas with the largest amounts of guano (= presence of bat colonies).

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